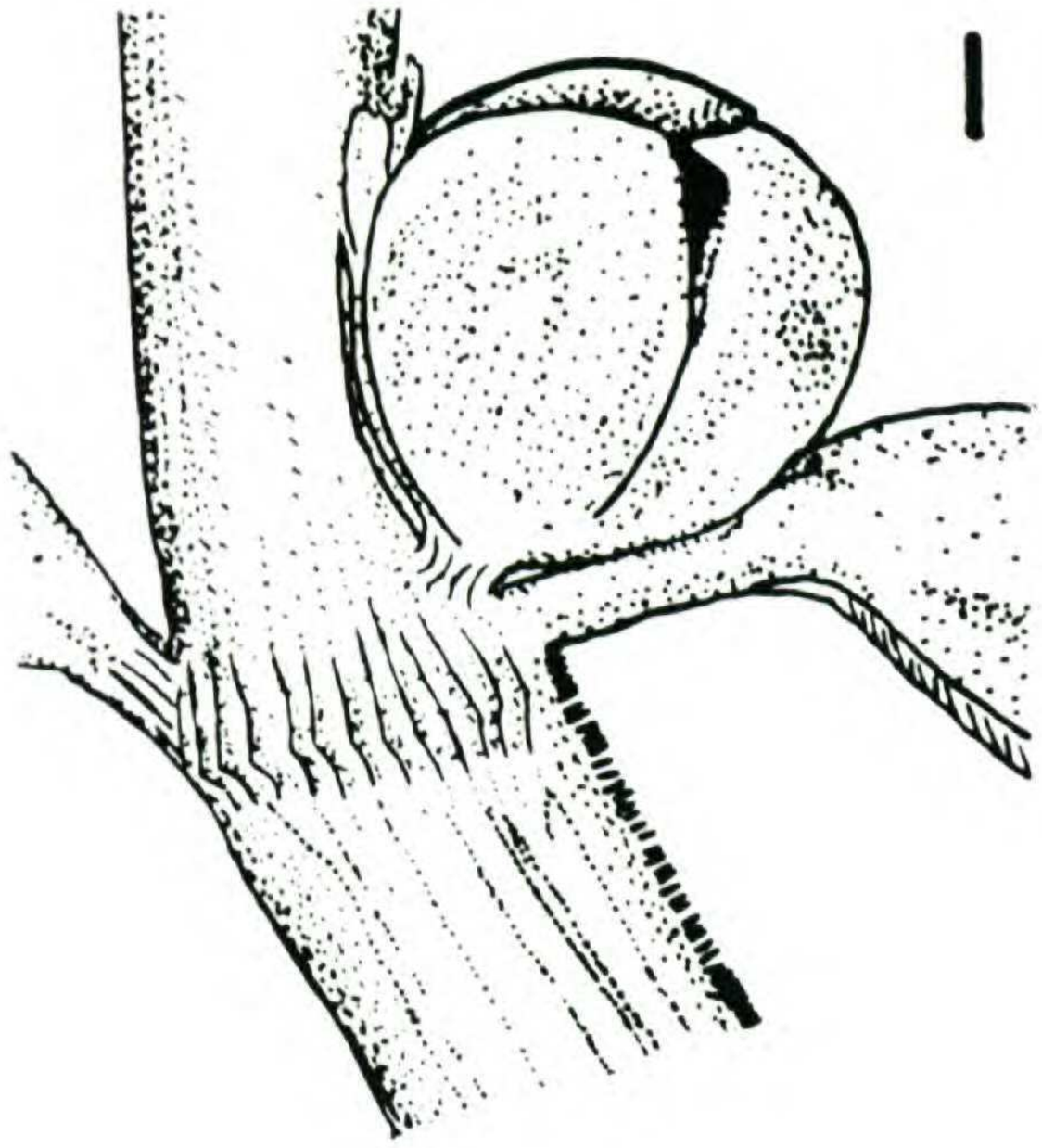
NEW ELATINE (ELATINACEAE) POPULATIONS IN THE SOUTHEASTERN UNITED STATES

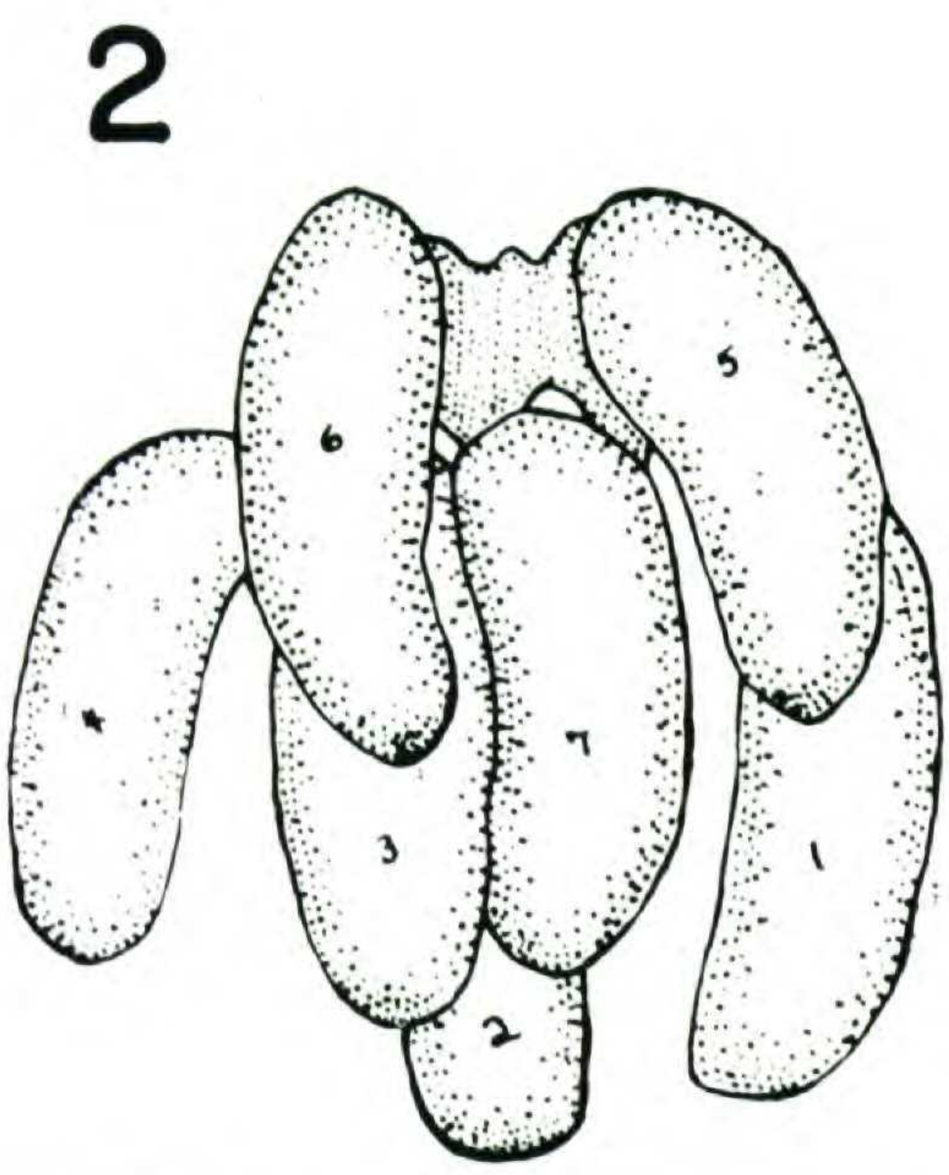
WILBUR H. DUNCAN

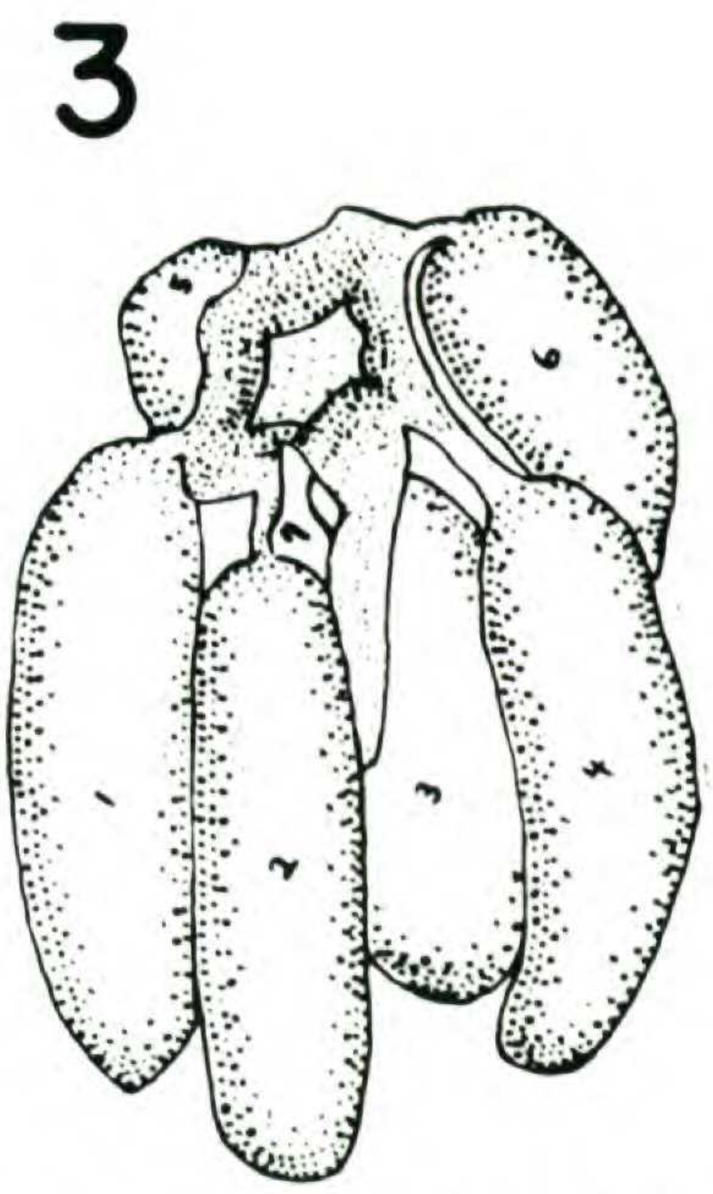
Literature to date indicates that *Elatine* is represented in the southeastern United States by *E. americana* (Pursh) Arn. which is reported for Tennessee by Small (1933) and Muenscher (1944) and for North Carolina by Small (1933), Muenscher (1944), and Radford (1951) who apparently missed the previous reports. Fassett (1939, 1957) reported no *Elatine* nearer to the southeast than Virginia, Ohio, or Illinois. Fernald's (1950) nearest reports are for *E. americana* and *E. minima* (Nutt.) Fisch. & Mey. in Virginia. Gleason (1952), however, acknowledges Small's report for *E. americana* for the southeastern states.

In 1960 Arthur Amerson, a student in a taxonomy class, brought in specimens of an aquatic which I identified from the meager material as *E. brachysperma* Gray. This collection was made on 8 May from a shallow pool of water on a granite outcrop 3.8 miles E27°S of Sparta, Hancock County, Georgia. The *Elatine* was associated with *Diamorpha cymosa* (Nutt.) Britton, a species characteristic of shallow soil of granite outcrops of the Piedmont Province of the southeast. On 28 October 1962 I collected abundant material of *Elatine* from a small pool of water in a depression of the granite outcrop at Echol's Mill 9.7 miles northeast of Lexington, Oglethorpe County, Georgia. The two sites are about 55 miles apart. Specimens from both sites are on deposit in the University of Georgia Herbarium. Additional material was collected at intervals from three pools at Echol's Mill during the following winter and spring and extensive studies made of all collections from Georgia and the few herbarium specimens on hand from other areas. Miss Jean Farr, an undergraduate major in Botany, ably assisted in these studies.

Live plants were observed at Echol's Mill during all months from October to June when the study was concluded. At some time during this period plants were found sub-







FIGURES 1-4. *Elatine triandra* from Oglethorpe Co., Georgia. Fig. 1. Mature fruit at node, × 20. Figs. 2-3. Opposing views of seven seeds attached to placenta from a single locule. Seeds are numbered for comparison, × 40. Fig. 4. Mature seed, × 50. Drawn by Jean Farr.

merged in water as deeply as 155 cm, emergent, or growing in moist soil. They were seen 0.8 to 46 cm tall (submerged), growing singly or in dense colonies, and unbranched to abundantly branched. Under such a variety of situations it was no surprise to me that leaf characteristics varied greatly. The extent of the variation was such that leaf characteristics used in keys to *Elatine* taxa by Fernald (1950), Muenscher (1944), and Fassett (1939) were of no diagnostic value. These observations support in part Fassett's (1939) contention that "Individuals of any species of *Elatine* grown under different conditions . . . resemble each other less closely than do individuals of different species. . . ."

The flowers of the Georgia material are three-merous and almost exclusively cleistogamous, most plants being submerged and the emergent ones flowering less abundantly. The fruits are all three-parted (Figure 1), three-loculed, and may attain a length of 1.5 mm. They apparently do not dehisce but rather the wall disintegrates or ruptures. I am following other authors in calling the fruits capsules, therefore, by interpreting the term in a broad sense. The number of seeds per capsule varied from 6 on small plants to 21 on some of the more vigorous plants. In the smaller capsules the fewer seeds were erect and terminated at about the same level, whereas in the larger capsules some seeds were erect while others were divergent and not terminating at the same level. All seeds were borne from or near the base of the capsule. The funiculi, however, sometimes varied in length. This caused distinct variation in seed position from capsule to capsule. See Figures 2 and 3 for opposing views of seven seeds attached to a placenta from a single locule. From our detailed study of individual seeds under a dissecting microscope at 40× and a compound microscope at 100× we determined that the seeds were nearly straight to slightly curved, 475-742μ long and 225-310μ wide, and the pits were angled and in 8-11 rows of 10-14 each. See Figure 4 for drawing of a typical seed.

This combination of characters is not found in the description given for any taxon recorded for eastern North America as may be seen from the following discussion. A comparison

of our data with descriptions given in literature indicates that the Georgia material can be neither *E. minima* (especially since this taxon has seeds with rounded pits) nor *E. americana* which according to Fassett (1939) has seeds in 6-8 rows of 16-25 pits each. Gleason (1952) also describes *E. americana* as having 16-25 pits while Fernald (1950) states that there are 20-30 in each row.

Can the Georgia material, therefore, be either *E. triandra* Schkuhr or *E. brachysperma* Gray which also are reported for the eastern United States? If we follow Fernald (1950) or Gleason (1952), both taxa are eliminated for these authors indicate that the seeds are borne along an axile placenta. Muenscher (1944) lists only *E. triandra* but agrees with the other authors in regard to placentation. If Fassett's (1957) key is followed, the Georgia material is *E. triandra* var. *brachysperma*. His illustration of the seed of this taxon, however, strongly indicates that the number of rows of pits can be scarcely more than six and is probably five. In Fassett's (1939) description for this taxon the pits are reported as being 6-8 rows. The Georgia material has 8 to 11 rows. Furthermore, maximum seed length exceeds his earlier (1939) value by 142μ. The Georgia material of *Elatine*, therefore, does not match the characters presented for any taxon recorded for eastern North America. Three interpretations of this situation seem possible. The material could be a new taxon, or a taxon new to the United States, or there may have been misinterpretation of the taxa in the United States. I believe the latter is true.

A major problem in properly delimiting the taxa in the past seems to have involved interpretation of the manner of placentation. Fernald (1941, 1950) maintains that *E. minima* and *E. americana* have basal placentation while in *E. triandra* and *E. brachysperma* it is axile. Gleason (1952), however, maintains that only *E. minima* has basal placentation and that the other three taxa (as varieties of a single species, *E. triandra*) ". . . have seeds borne along an elevated placenta, therefore overlapping and terminating at different levels." Placentation is not utilized by Fassett (1939, 1957). Under Fernald's interpretation of placenta-

tion the Georgia material can be only *E. americana* yet characteristics of the seeds do not match (pits 10-14 per row instead of 20-30 and diameter 225-310μ instead of 140-190μ). It seems probable that Fernald was misled about seed arrangement, with Gleason (1952) and Muenscher (1944) apparently falling into the similar error. It seems significant that Miss Farr and I were misled by some of our earlier dissections. I now believe that all species of Eastern North America have placentae near the lower part of the locule.

If placentation is considered to be uniformly at the base, then how shall the taxa represented in eastern North America be interpreted? *E. minima* seems quite distinct with rounded pits and flowers mostly two-merous, the other taxa having angular pits and three-merous flowers. Let us next examine separation of these latter taxa on the basis of seed characteristics, which appear to be the only ones of diagnostic value. Seed characteristics obtained from literature for these taxa and for a South American taxon (*E. triandra* var.

Table 1. Seed characteristics for the *Elatine* taxa and population indicated. Some data were taken directly from the authors cited while other data were determined from drawings made to scale. The names are not designated as to whether or not they are species or varieties for some have been treated as both.

CATEGORY		No. rows of pits	No. pits per row	Length μ	Width μ
triandra	Fassett, 1957	6	—	580	170
	Fernald, 1950	—	16-25	—	—
	Gleason, 1952	—	16-25	—	—
americana	Fassett, 1939[1]	6-8	16-25	400-720	140-250
	Fernald, 1950	—	20-30	—	140-190
	Muenscher, 1944	—	—	540	—
	Gleason, 1952	—	16-25	—	—
brachysperma	Fassett, 1939	6-8	9-16	350-600	160-300
	Fassett, 1957	—	—	420	—
	Gleason, 1952	—	9-15	—	—
	Fernald, 1950	—	9-15	—	—
andina	Fassett, 1939	8-10	12-19	460-680	160-280
Georgia material		8-11	10-14	475-742	225-310

[1]Fassett gives same data for *genuina* of Europe.

andina Fassett), and that determined for the Georgia material are summarized in Table 1. On the basis of these data *triandra* and *americana* appear to be the same, and may be separable from the Georgia material and *andina* which two also appear identical. A third taxon, *brachysperma*, may be distinguishable. Should, therefore, three taxa be recognized? The following seem pertinent to this question. First, there is overlap of values given for each characteristic. Secondly, a continuous morphological series of populations (most of which are probably relatively constant at each locality) seems likely to occur in nature. This is supported by Fassett (1939) who said that seed characteristics vary from locality to locality but are remarkably constant at each locality. Such "pure lines" are to be expected as a result of the self-pollination which apparently occurs abundantly under the predominately cleistogamous situation. Until evidence to the contrary is available I believe that the best way to treat this series of anastomosing populations of often different yet locally relatively constant characteristics is as one taxon, a species with no varieties. Under this interpretation *Elatine* in Eastern North America would consist of this species and *E. minima*. This most nearly agrees with Fassett's (1957) general interpretations except for some varieties which he maintains. The alternative to this thesis would be to accept three obviously closely related taxa (other than *E. minima*) for Eastern North America, one taxon being *andina* whose distribution would be Georgia, U. S. A. and Chile, South America.

Under my interpretation, all known *Elatine* of Eastern North America are either *E. minima*, with rounded pits on the seeds, or *E. triandra*, with angular pits on the seeds. A partial synonomy related to Eastern North America for the latter species follows:

Elatine triandra Schkuhr, Bot. Handb. 1, 345, t. 109b, fig. 2. 1791.
Elatine americana (Pursh) Arnott, Edinb. Journ. Nat. & Geogr. Sci. 1: 431. 1830.
Elatine brachysperma Gray, Proc. Am. Acad. 13: 361. 1878.
Elatine rubella Rydberg, Mem. N. Y. Bot. Gard. 1: 260. 1900.
Elatine triandra var. *americana* (Pursh) Fassett, Rhodora 33: 73. 1931.

Elatine triandra var. *brachysperma* (Gray) Fassett, Rhodora 41: 374. 1939.

It seems likely that material from other areas (e.g. *E. triandra* var. *andina* from Chile, *E. triandra* var. *genuina* from Europe) also belong in this species without varietal status.

The distribution by states for *Elatine triandra* in the eastern part of the United States as determined from literature and herbarium records is as follows: Missouri, Illinois, Ohio, Maine, New York, Connecticut, Pennsylvania, Delaware, Virginia, Tennessee, North Carolina, and Georgia.

DEPARTMENT OF BOTANY, UNIVERSITY OF GEORGIA,
ATHENS, GEORGIA.

Literature Cited

Fassett, Norman C. 1939. Notes from the herbarium of the University of Wisconsin — XVII. *Elatine* and other aquatics. Rhodora **41:** 367-377.

———. 1957. A manual of Aquatic Plants, Revised Ed., University of Wisconsin Press, Madison. 405 pp.

Fernald, Merritt L. 1941. *Elatine americana* and *E. triandra*, Rhodora **43:** 208-211.

———. 1950. Gray's Manual of Botany. 8th Ed. Amer. Book Co. N. Y. 1632 pp.

Gleason, Henry A. 1952. The new Britton and Brown Illustrated Flora of the northeastern United States and adjacent Canada. Vol. 2. New York Bot. Garden. N. Y. 546-547.

Muenscher, Walter C. 1944. Aquatic plants of the United States. Comstock Pub. Co., Inc. Ithaca, N. Y. 374 pp.

Radford, Albert E. 1951. Additions to the Flora of North Carolina. Rhodora **53:** 23-27.

Small, John K. 1933. Manual of Southeastern Flora. Univ. of North Carolina Press, Chapel Hill. Reprint. 1554 pp.